

I published my account of this singular species in the 'Ibis' (1869, p. 304) several additional and interesting particulars have been added to its life-history by Mr. Potts (Trans. N. Z. Inst. vol. iii. p. 93) and by Mr. Buller (Birds of New Zealand, p. 216).

The egg, however, has not hitherto been figured; and the following notes, by the collector, will doubtless be acceptable to ornithologists. Mr. J. R. Cook, the collector above referred to, reports that he took the egg here figured with two others from a nest in the Otaio river-bed, Canterbury Settlement, on the 20th October, 1872. The nest was on sand amongst shingle, and very hard to find, although the birds were bold. The eggs were placed point downwards and were almost covered with small pieces of lichen, apparently placed there by the bird for the purpose of concealing them during its absence from the nest.

#### EXPLANATION OF PLATE LX.

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| Fig. 1. <i>Glarcola lactea</i> , p. 455.  | Fig. 7. <i>Ægialitis collaris</i> , p. 458.       |
| 2. <i>Pluvianus ægyptius</i> , p. 456.    | 8. — <i>ruficapillus</i> , p. 459.                |
| 3. <i>Hoplopterus ventralis</i> , p. 455. | 9. — <i>nigrifrons</i> , p. 459.                  |
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| 5. — <i>tricollaris</i> , p. 457.         | 11. <i>Anarhynchus frontalis</i> , p. 459.        |
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#### 11. On Fossil *Arvicolidæ*. By HUMPHREY P. BLACKMORE, M.D., and EDWARD R. ALSTON, F.Z.S.

[Received June 10, 1874.]

In the following pages we have attempted to review the information which we at present possess as to *Arvicolidæ* that have been found in a fossil state, and their relationship to recent species. In the course of our investigations the conclusion has been forced upon us, that in many cases it is not possible to identify and define species of this family by the pattern of the molar teeth *alone* with the accuracy which has been claimed; and as these are the only characteristic remains which are forthcoming in the case of most of the fossils, it follows that some of our determinations are and must be merely approximate.

Blasius seems to have been the first to recognize the diagnostic value of the form and number of the prisms which form the crowns of the molars in the *Arvicolidæ*; and when taken along with other structural details and with external characters they afford an invaluable key to the numerous species and varieties of this most difficult group. But when considered alone they are not conclusive in every case. Thus, for example, *A. arvalis* cannot be separated by its teeth from the very distinct *A. subterraneus*, while many species are liable to occasional individual variations which might well be regarded as showing specific distinction if other characters were overlooked. Again, the form and proportions of some of the bones of the skull vary very considerably according to the age of the animal—a fact which has been overlooked by many writers

(as Prince Bonaparte and M. Pomel), who have attributed specific value to slight cranial differences. In accordance with these views we have thought it necessary considerably to reduce the number of recorded species.

Remains of *Arvicolidæ* have been found in the upper beds of the Norwich Crag series, in the breccia of the Mediterranean islands, in brick-earths and other deposits of the Drift period, and in many bone-caves in England, France, Belgium, Germany, and Italy. When not identical with the species now inhabiting these countries, they show affinity, as might be expected, with North-European and Siberian forms; and the two species of restricted *Myodes*, in particular, are very characteristic of the glacial fauna of which they were members.

Before proceeding to the enumeration of the species, we have to express our best thanks to those who have assisted us with information and the loan of specimens, especially to the Committee of the Norfolk and Norwich Museum, to Sir Charles Lyell and Prof. Owen, Messrs. Boyd Dawkins and Sanford, Mr. Moore, of Bath, Messrs. Southwell, Harmer, and Reeve, of Norwich, and Mr. Bidgood, of Taunton.

#### 1. ARVICOLA GLAREOLUS (Schreber).

1846. *Arvicola pratensis*, Owen, Br. Foss. Mamm. p. 208, fig. 78.

1852 (?). *Arvicola delarbrei* (sp. n.), Pomel, Ann. Sc. de l'Auvergne, xxv. p. 362.

1855. *Arvicola glareolus*, Hensel, Zeits. d. Deutsch. Geol. Ges. vii. p. 483.

1866. *Arvicola pratensis*, Boyd Dawkins & Sanford, Pleistoc. Mamm. (Introd.) p. xxxvi.

1869. *Arvicola pratensis*, Boyd Dawkins, Q. J. Geol. Soc. xxv. p. 194.

1870. *Arvicola glareolus*, Sanford, *ibid.* xxvi. p. 124.

The Red Field-Vole was first noticed as a fossil species by Prof. Owen, under Baillon's name of *A. pratensis*, some remains obtained by Mr. McEnery from Kent's Hole, now in the British Museum, having been identified by Mr. Waterhouse. M. Pomel's *A. delarbrei*, from the Brèche de Coudes, is stated to be a little larger than *A. glareolus*, and to differ slightly in the details of the molars; but these are points in which individual variations are constantly found in the recent animal. The species appears to have been rare in England in Pleistocene times; Mr. Boyd Dawkins added no new localities; and Mr. Sanford had only seen two jaws, one of which, from Hutton Cave, is in the Taunton Museum. Mr. C. Moore has found a detached first lower molar in a cavern near Bristol; we have a jaw from Wookey Hole in our own collection; and a fragmentary jaw and some separate teeth from the Norfolk forest-bed series are in the Norwich Museum.

*A. glareolus* has a recent European range north of the Alps and Apennines, extending to within the Arctic Circle and to the Ural

Mountains; and it is widely but locally distributed throughout Britain. Its fossil remains do not appear to have been recognized, except in France and England.

The molars of this species are distinguished from those of all the other known Voles (except the nearly allied *A. rutilus*, Pall.) by the development in the adult animal of distinct roots, whence it has been generically separated under the name *Hypudæus*, Illig.\* The enamel-folds are proportionally thicker than in the other species, the cemental spaces are more rounded, and the anterior ones of the first lower molar are more distinctly separated. The pattern, which is liable to slight individual variation, especially in the third upper molar, is as follows:—

<i>Upper</i>	I.	5 spaces	6 angles.	<i>Lower</i>	I.	7 spaces	9 angles.
„	II.	4 „	5 „	„	II.	5 „	6 „
„	III.	6 „	7 or 8 „	„	III.	3 „	6 „

We have examined the specimens in the British, Taunton, and Norwich Museums, and in our own collection.

## 2. ARVICOLA AMPHIBIUS (Linn.).

1823. *Water-Rat*, Buckland, Rel. Diluv. p. 18, plate xi. figs. 1-6, 12-18.

1825. *Campagnol des cavernes*, Cuvier, Ossem. Foss. v. pt. i. p. 54.

1846. *Arvicola amphibia*, Owen, Br. Foss. Mamm. p. 201, fig. 76.

1846. (?) *Arvicola*, sp.?, Owen, *ibid.* p. 205.

1847. "*Hypudæus spelæus*, Cuv.," Giebel, Fauna der Vorwelt, i. p. 88.

1852. (?) *Arvicola antiquus*, sp. n., Pomel, Ann. Sc. de l'Auvergne, xxv. p. 361.

1852. (?) *Arvicola robustus*, sp. n., Pomel, *ibid.* p. 362.

1855. (?) *Arvicola*, sp.?, Lyell, Man. Elem. Geol. (5th ed.), pp. 156, 168, fig. 146.

1866. *Arvicola amphibia*, Boyd Dawkins & Sanford, Pleist. Mamm. (Introd.) p. xxxvi.

1869. *Arvicola amphibioides*, Boyd Dawkins, Q. J. Geol. Soc. xxv. p. 194.

1870. *Arvicola amphibioides*, Sanford, *ibid.* xxvi. p. 124.

Dr. Buckland found the remains of the "Water-Rat" so abundant in the Kirkdale Cave that almost every fragment of the osseous breccia which he examined contained teeth or broken bones, several of which he figured. Cuvier examined specimens from the same locality, and found them to agree well with this species, but remarked that, although larger than the remains from Sardinia and Corsica (= *A. brecciensis*, see p. 466), they were smaller than the recent *A. amphibioides*. On this observation Dr. Giebel founded his "*Hyp. spelæus*, Cuv." Prof. Owen, however, found that speci-

\* Dr. Forsyth Major mentions a large species, resembling *A. amphibioides* but with rooted molars, as found in the lignites of Lefte, in Lombardy, but has not yet named or described it (Atti Soc. Ital. Sc. Nat. xv. p. 584).

mens from Kent's Hole, agreeing closely in character with those from Kirkdale, were not inferior in size to the existing Water-Vole. Dr. Schmerling figures what appears to be the present species from the Belgian bone-caves ('Oss. Foss. des Cavernes de Liège,' 1833). In 1852 M. Pomel described two new species, *A. antiquus* and *A. robustus*, from the Brèche de Coudes and other French deposits, defining them by slight cranial differences, probably attributable to age, and by the anterior space of the first lower molar being rounded in the first and almost triangular in the second—a variation constantly met with in *A. amphibius*.

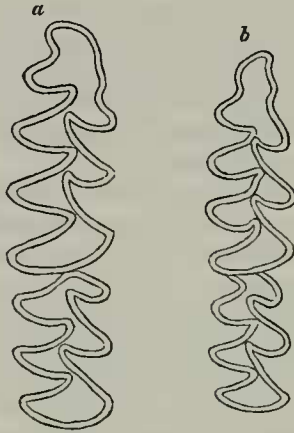
In considering the size of fossil Voles allied to the present, it must be remembered that several races now exist in Europe which vary very greatly in this respect, and which are often regarded as distinct species. Of these the best marked are *A. amphibius* (Linn.), *A. terrestris* (Linn.), and *A. destructor*, Savi; and it has been shown by Blasius (Säugeth. Deutschl. pp. 344–358) and by Fatio ('Campagnols du Léman,' pp. 36–48), that although typical examples of each form are very different in size, proportions, and external characters, yet they run into one another by such numerous gradations that it is impossible to find constant characters by which they may be defined and separated. Such being the case with the recent animal, it is, of course, all the more impossible to separate fossils by the teeth and jaws alone.

Prof. Owen mentions some portions of upper and lower jaws from "the older Pliocene crag near Norwich," found along with molars of *Mastodon angustidens*, as indicating a species of *Arvicola* intermediate in size between *A. amphibius* and *A. agrestis*. Sir C. Lyell, in his 'Elements' (5th ed.), figures these teeth, though on too small a scale for satisfactory identification, but remarks that he does not now regard these beds as *older* Pliocene, believing that some of their fossils, including perhaps the Mastodon, may have been washed out of the Red Crag. Prof. Owen having kindly informed us that the specimens in question had been in the collection of the late Miss Gurney of Northrepps, and were now in the Norfolk and Norwich Museum, we applied, through our friend Mr. Southwell, to the authorities of that institution, who most liberally allowed us every facility for their examination; and Mr. Reeve, the curator, has also obliged us with the loan of specimens from his private cabinet. Those from the Gurney collection are labelled "Ostend;" and Mr. F. W. Harmer kindly informs us that they are doubtless from the preglacial forest-bed series at that place (between Buckton and Hasbro', on the Norfolk coast). Mr. Reeve's examples are a single jaw from the *upper* bed of crag at Bramerton, and others from the freshwater beds overlying the forest-bed at Runton, near Cromer: Mr. Harmer considers these last of similar age to the Ostend deposits, and the fossils are identical in appearance. The Bramerton jaw (fig. 1, *a*, p. 464) is not inferior in size to ordinary English examples of *A. amphibius*, with which it perfectly agrees in dentition. The same remark applies to some teeth from Ostend; but other specimens from that locality (fig. 1, *b*, p. 464) and from



Runton are much smaller, being slightly less (and the jaws perhaps more slender) than in a Swiss skull of the small *terrestris* race. It

Fig. 1.



Teeth of *A. amphibius*.

is evident, therefore, that Prof. Owen was right in refraining from definitely separating these fossils from the recent *A. amphibius*, although the animal *may* of course have been sufficiently distinct, and also that the deposits in which they occur are much more recent than was formerly supposed.

At the present day *A. amphibius* ranges throughout all Europe, and extends through the Caucasus to Persia, and to Northern Asia as far as the Sea of Okhotsk. The *destructor* race inhabits the Mediterranean countries; and the small *terrestris* form is principally found in the mountainous parts of Central Europe. Remains of the Water-Vole are found abundantly in many drift-deposits, and in most of the bone-caves of England, France, Belgium, and Germany.

The form of the teeth is very constant, except in minor details, and does not vary in the different races. The pattern is:—

<i>Upper</i>	I.	5 spaces,	6 angles.	<i>Lower</i>	I.	7 spaces,	9 angles.
„	II.	4 „	5 „	„	II.	5 „	6 „
„	III.	5 „	6 „	„	III.	5 „	6 „

We have compared the fossils in the British, Norwich, and Taunton Museums, and in our own collection with recent skulls from England, Scotland, and Switzerland.

### 3. ARVICOLA RATTICEPS, Keys. et Blas. (?).

1870. *Arvicola ratticeps*, Sanford, Q. J. Geol. Soc. xxvi. p. 125, pl. viii. fig. 1 a-d.

Among the Somersetshire cave-fossils in the Taunton Museum, Mr. Sanford recognized a part of a skull and several lower jaws as being undistinguishable from this northern species. In 1861 we had found a large number of jaws and other remains in a deposit of

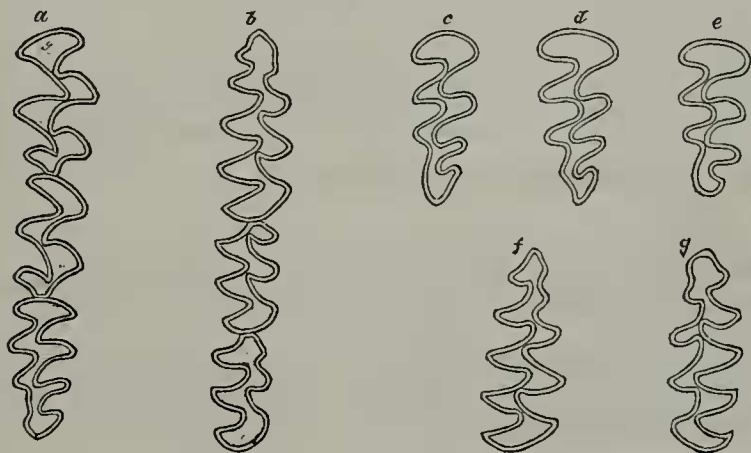
brick-earth of the Drift period at Fisherton, near Salisbury, associated with *Myodes torquatus*, *Spermophilus erythrogonoides*, &c.; and these we find to be certainly the same as the Somersetshire specimens. A skull from the Bromberg cavern (from the Scæmering collection) is in the British Museum.

On comparing the dental pattern of these fossils with Blasius's figures of *A. ratticeps* (Säugeth. Deutschl. p. 366) we were struck with the great variety of form in the anterior part of the first lower molar, and more especially in the posterior part of the third upper molar. We were at one time inclined to believe that the fossil might be regarded as a distinct species, and are still of opinion that it may represent a race distinct from the recent *A. ratticeps*; but the variations are so great, both in the recent and the fossil skulls, that we have sought in vain for any constant characters for specific distinction.

In the first lower molar many specimens agree exactly with *A. ratticeps*, but in others the anterior extremity is produced beyond the first inner angle, so as to give the tooth the appearance of having *eight* cemental spaces instead of *seven*: this type is somewhat exaggerated in Mr. Sanford's fig. 1 *d*. The outer margin of the first two blended spaces is often less regularly convex than is usually the case in recent *A. ratticeps*, so that the whole tooth rather resembles Middendorff's illustration of *A. obscurus* ('Sib. Reise,' ii. pl. xi. fig. 4), and Hensel's of his *A. ambiguus* (= *A. brecciensis*, see p. 466).

But the most remarkable variation occurs in the third upper molar, which differs so much that it is only the numerous intermediate forms that convince us that all belong to the same species. A few, like that figured by Mr. Sanford, agree with typical *A. ratticeps* in having four external and four internal angles; but in many there are only *three* external angles, and the whole form of the tooth more resembles that of *A. arvalis*, while others present a type peculiar to themselves. All we have yet examined differ from *A. brecciensis* in having more than three internal angles (fig. 2, *a-f*).

Fig. 2.

Teeth of *A. ratticeps* and *A. nivalis*.

The recent skulls of *A. ratticeps* present considerable variations, though not to the extent shown in the fossils. In some the first lower molar shows a slight approach to the prolongation of the anterior extremity alluded to above; and Blasius himself remarks that the variation in the last upper tooth may lead to the formation of false species (*l. c.* p. 368). We must therefore regard the fossil animal as either identical with the recent, or as so nearly allied as not to be separable by the materials which remain to us.

The recent range of this Vole extends from Scandinavia (where Nilsson described it as *Lemmus medius*) through Lapland, North Russia, and Siberia as far as Kamtschatka.

The most striking character in its dentition is the manner in which the first two external angles of the first lower molar are blended in a broad convex pillar. The pattern is:—

<i>Upper</i>	I. 5 spaces,	6 angles.	<i>Lower</i>	I. 7 spaces,	9 angles.
„	II. 4 „	5 „	„	II. 5 „	6 „
„	III. 7 „	7 or 8 „	„	III. 3 „	6 „

We have examined all the specimens above referred to, and have compared them with recent skulls in the British Museum and in our own collection.

#### 4. ARVICOLA NIVALIS, Martins.

1873. *Arvicola nivalis*, C. J. Forsyth Major, Atti Soc. Ital. Sc. Nat. xv. p. 584.

Dr. Forsyth Major has recently announced the discovery of the remains of this alpine species in the Cavern of Levrage in Lombardy. A single jaw found along with these, of the last species, at Fisherton, has much the character of *A. nivalis* in the form of the first molar (fig. 2, *g*, p. 465); but the variation in the other teeth among which it was discovered leads us to hesitate in describing the species as British until further evidence is obtained.

At the present day this species seems to be confined to the Alps of Central Europe, where it is found at an elevation of not less than 3000 feet above the sea-level; according to De Selys Longchamps it also inhabits the Pyrenees.

The dentition does not appear to be liable to much variation. The anterior extremity of the first lower molar is convex, passing at once into the first exterior or internal angles. The pattern is:—

<i>Upper</i>	I. 5 spaces,	6 angles.	<i>Lower.</i>	I. 8 spaces,	9 angles.
„	II. 4 „	5 „	„	II. 5 „	6 „
„	III. 6 „	6 „	„	III. 3 „	6 „

We have compared the single jaw figured with recent skulls of *A. nivalis* from Switzerland in the British Museum.

#### 5. ARVICOLA BRECCIENSIS (Giebel).

1825. *Campagnol de Cette, de Corse, et de Sardaigne*, Cuvier, Oss. Foss. iv. p. 225, v. pt. i. p. 54.

1847. *Hypudæus brecciensis*, sp. n., Giebel, Fauna d. Vorwelt, i. p. 88.

1855. *Arvicola ambiguus*, sp. n., Hensel, Zeits. d. Deutsch. Geol. Ges. vii. p. 469, pl. xxv. figs. 3, 8, 9 (*nec* Pomel).

1859. *Arvicola brecciensis*, Gervais, Zool. et Paleont. Franç. (2<sup>me</sup> ed.) p. 41.

A species of *Arvicola*, found in the breccia of the Mediterranean islands, was described but not systematically named by Cuvier, and subsequently by Wagner (Karsten's Archiv, xv. p. 10); and on these descriptions Dr. Giebel founded his *Hypudæus brecciensis*. On the ground that Giebel had not given sufficient diagnostic characters, Hensel re-named it *A. ambiguus*, overlooking the previous employment of that name by Pomel (see below, p. 469). Hensel defines the species as having *three* external and *three* internal angles to the third upper molar, and *four* external and *five* internal angles to the first lower molar. He considers that its nearest affinities among living forms were with the Siberian *A. obscurus*, the size and the form of the first lower molar agreeing well with Middendorff's figure of that species; but the third upper molar was very different, and the facial portion of the skull was shorter.

According to Hensel's figures and description, the pattern was:—

Upper	I.	5 spaces,	6 angles.	Lower	I.	7 spaces,	9 angles.
„	II.	4 „	5 „	„	II.	5 „	6 „
„	III.	5 „	6 „	„	III.	4 „	6 „

We have not seen specimens of this Vole; but if Hensel's characters are constant, the species would appear to be a good one.

#### 6. ARVICOLA AGRESTIS (Linn.).

1823. *Young Water-Rat*, Buckland, Rel. Diluv. p. 265, plate xi. fig. 11.

1825. *Petit Campagnol des Cavernes*, Cuvier, Ossem. Foss. v. pt. i. p. 54.

1846. *Arvicola agrestis*, Owen, Br. Foss. Mamm. p. 206, fig. 77.

1847. *Hypudæus bucklandii*, sp. n., Giebel, Fauna d. Vorwelt, i. p. 88.

1852. (?) *Arvicola arvaloides*, sp. n., Pomel, Ann. Sc. de l'Auvergne, xxv. p. 362.

1852. (?) *Arvicola joberti*, sp. n., Pomel, *ibid.* p. 363.

1866. *Arvicola agrestis*, Boyd Dawkins & Sanford, Pleist. Mamm. (Intro.) p. xxxvi.

1869. *Arvicola agrestis*, Boyd Dawkins, Q. J. Geol. Soc. xxv. p. 194.

1870. *Arvicola agrestis*, Sanford, *ibid.* xxvi. p. 124.

Small remains of *Arvicolæ*, found in the Kirkdale Cave, were attributed by Dr. Buckland to "young Water-Rats." He sent specimens to Cuvier, who observes that they were not larger than *A. arvalis*, but that a femur was proportionally thicker, and that the pelvis figured by Buckland resembled *A. œconomus* rather than *A. arvalis*. At that time *A. agrestis* was universally confused with the



common continental *A. arvalis*, and Cuvier probably never compared the fossils with the former species. Prof. Owen rightly identified the Kirkdale and Kent's-Hole specimens in the British Museum with *A. agrestis*, though he retained in the error of giving "*Mus arvalis* of Pallas" as a synonym. Dr. Giebel, on the strength of Cuvier's remarks, bestowed the name *Hypudæus bucklandii* on the Kirkdale Vole\*. In 1852 M. Pomel described *A. arvaloides* and *A. joberti* as allied to *A. neglectus* (= *agrestis*, cf. Blasius, Säugeth. Deutschl. p. 372), and distinguished only by slight cranial differences, to which no weight can be given. *A. agrestis* has been found in many bone-caves and other deposits in Britain. Mr. Sanford considers that in the Somersetshire specimens the diastema between the incisors and molars is longer, and the whole jaw straighter than in recent skulls. We have received jaws from the fissures in the limestone rocks near Bath, which exactly agree with recent specimens.

The species is widely spread throughout Northern and Central Europe, from Scandinavia and Finland to the Alps, but is most plentiful in the North. It is the commonest species almost everywhere in Britain, though *A. glareolus* appears to exceed it in numbers in some parts of Scotland.

The teeth of *A. agrestis* may be recognized at a glance, by the fact that the second upper molar has *five* cemental spaces instead of *four*. The third upper molar sometimes shows a very minute supplementary angle on the outside; this we have found both in recent and fossil skulls. The pattern is:—

<i>Upper</i>	I.	5 spaces,	6 angles.	<i>Lower</i>	I.	9 spaces,	10 angles.
"	II.	5 "	6 "	"	II.	5 "	6 "
"	III.	6 "	7 or 8 "	"	III.	3 "	6 "

We have examined the specimens in the British and Taunton Museums and in our own collection.

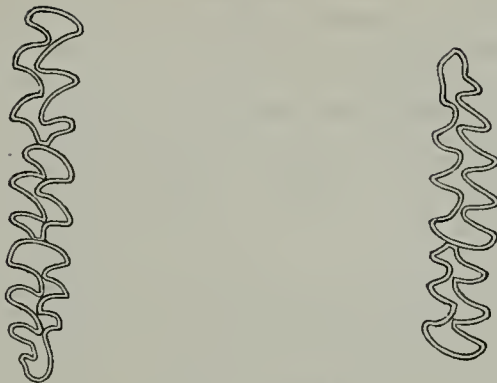
#### 7. ARVICOLA ARVALIS (Pallas).

1873. *Arvicola arvalis*?, Forsyth Major, Atti Soc. Ital. Sc. Nat. xv. p. 589.

Several jaws found in fissures in the limestone rocks near Bath, which have been sent to us by our friend Mr. Moore, belong undoubtedly to a small group of Voles comprising *A. arvalis*, *A. saxatilis*, and *A. gregalis*, none of which are now natives of Britain. These species agree so closely in dentition that it is impossible to decide positively to which the fossils should be ascribed. In size and proportions they agree very closely with Siberian skulls of *A. saxatilis* in the British Museum; but they also much resemble some specimens of *A. arvalis*. As Dr. Forsyth Major has lately doubtfully referred similar examples (found in the Cavern of Levrance

\* Through a misreading of Cuvier's observations on the remains of *Mures* found by Buckland in the same cave, Giebel founded his *Hyp. minimus* (l. c. p. 88), which, consequently, is a synonym of some species of Mouse, probably *M. sylvaticus* (cf. Hensel, l. c. p. 484).

Fig. 3.

Teeth of *A. arvalis*.

and in the bone-breccia of Oliveto, near Pisa) to *A. arvalis*, we have thought it best provisionally to apply the same name to the Bath fossils.

This is the commonest species of Field-Vole in Central Europe, extending into Western Siberia, and, according to Radde, even as far east as the desert of Gobi. It is not found in Scandinavia, nor in Britain, and in Italy it appears to be confined to the northern provinces, being replaced in the former countries by *A. agrestis*, and in the south of Italy by *A. savii*.

The dentition varies slightly, the pattern being:—

<i>Upper</i>	I.	5 spaces,	6 angles.	<i>Lower</i>	I.	8 spaces,	9 angles.
„	II.	4 „	5 „	„	II.	5 „	6 „
„	III.	6 „	7 „	„	III.	3 „	5 „

We have compared the fossils with recent skulls in the British Museum and in our own collection.

#### 8. MYODES TORQUATUS, Pall.

1852. (!) *Arvicola ambiguus*, Pomel, Ann. Sc. de l'Auvergne, xxv. p. 363 (*nec* Hensel).

1855. *Misothermus torquatus*, Hensel, Zeits. d. Deutsch. Geol. Ges. vii. p. 492, pl. xxv. figs. 12, 13.

1864. *Lemmus grœnlandicus?*, Blackmore, *ap.* Evans, Q. J. Geol. Soc. xx. p. 192.

1866. *Lemmus*, sp., Boyd Dawkins & Sanford, Pleist. Mamm. (Intro.) p. xxxvi.

1869. *Lemmus*, sp., Boyd Dawkins, Q. J. Geol. Soc. xxv. p. 194.

1870. *Lemmus torquatus*, var., Sanford, *ibid.* xxvi. p. 125, pl. viii. figs. 4, 4 a.

1870. *Arvicola gulielmi*, sp. n., Sanford, *ibid.* xxvi. p. 125, pl. viii. figs. 2 a, b.

1873. *Myodes torquatus*, Forsyth Major, Atti Soc. Ital. Sc. Nat. xv. p. 111, pl. 2.

In 1852 M. Pomel described *Arvicola ambiguus*, a new species

from the Brèche de Coudes, with twelve angles to the first lower molar. Counting the anterior extremity as an angle, this agrees with the present animal; and the rest of his description applies so well as to leave no doubt that he had a Lemming of this species before him. Three years later Hensel recognized this species among fossils from the diluvium of Quedlinburg, in Saxony, in the Mineralogical Museum of Berlin. In this country we discovered it in some numbers in 1865 in the drift-deposits at Fishertou; and next year Mr. W. Flower sent us some specimens for identification, procured from Wookey Hole. In 1870 Mr. Sanford recognized part of a skull in the Taunton Museum as only differing from recent specimens in being slightly larger. At the same time he referred six lower jaws in the same collection to a new species of *Arvicola*, which he provisionally named *A. gulielmi*, remarking that they might prove the same as Pomel's *A. ambiguus*. Dr. Forsyth Major has since pointed out that these appear to be the lower jaws of the present species—a conclusion at which we had independently arrived, and in which we believe Mr. Sanford now fully concurs. Remains from Hohlenstein, near Ulm, are described by Dr. Forsyth Major; and a fine skull from Eppelsheim, near Darmstadt, is in the British Museum.

Middendorff has clearly shown ('Sibir. Reise,' ii. th. 2, pp. 87–99) that *M. hudsonius*, Pall., *M. grœnlandicus* (Trail), and *Lemmus ungulatus*, Baer, are all identical with *M. torquatus*, whose range may therefore be described as circumpolar. It is found in the Hudson-Bay countries, in Novaja Zemlja, from the White Sea to the Obi, in Taimyrland, on Baer Island, and Novaja Siberia, and from the Lena to the Jana. It appears to be very rare in Greenland (*cf.* Brown, P. Z. S. 1868, p. 349), and is not found in Russian Lapland. Parry found a skeleton in N. lat. 82°, while it reaches its most southern point in Unalaska, under N. lat. 54°. In postpliocene times it appears to have extended at least as far south as Germany, England, and the basin of the Loire.

In this species the prisms of the posterior molars are not compressed and twisted as in the typical *Myodes*, but are placed regularly as in *Arvicola*; and Hensel has consequently separated it as a new genus, under the name *Misothermus*. The pattern, which appears to be very constant, is:—

<i>Upper</i>	I.	7 spaces, 8 angles.	<i>Lower</i>	I.	9 spaces, 11 angles.
„	II.	6 „ 7 „	„	II.	5 „ 7 „
„	III.	6 „ 8 „	„	III.	4 „ 6 „

We have compared recent and fossil skulls in the British and Taunton Museums and in our own collection.

### 9. MYODES LEMMUS (Linn.).

1855. *Myodes lemmus*, Hensel, Zeits. d. Deutsch. Geol. Ges. vii. p. 486, pl. xxv. figs. 10, 11, 15.

1870. *Lemmus norvegicus*, var., Sanford, Q. J. Geol. Soc. xxvi. p. 125, pl. viii. figs. 3 a, b.

The Norwegian Lemming was first detected in a fossil state by Hensel, who found remains in the same deposits at Quedlinburg as the last species. In Britain it has only been found, as far as we are aware, in the Somersetshire bone-caves. Six lower jaws from these caverns are in the Taunton Museum, and were identified with this species by Mr. Sanford, although he remarks that they are slightly smaller and have the condyle somewhat more slender than recent specimens. They agree, however, so closely, especially with skulls of young animals, that we do not think there can be any doubt as to their identity.

At the present day *M. lemmus* is very restricted in its range, being found only in the Scandinavian peninsula and in Russian Lapland. In the postpliocene epoch it extended at least as far south as Saxony and England.

In this species, as in the allied *M. obensis*, the prisms of the posterior molars in both jaws are nearly separated from each other, the folds of enamel passing almost completely across the tooth; they are much twisted and compressed longitudinally. The last upper molar sometimes varies slightly; but the rest of the pattern is very constant, being:—

<i>Upper</i>	I.	5 spaces,	6 angles.	<i>Lower</i>	I.	5 spaces,	7 angles.
„	II.	4 „	5 „	„	II.	5 „	6 „
„	III.	4 „	6 or 7 „	„	III.	4 „	5 „

We have compared the jaws in the Taunton Museum with recent specimens in our own collection.

12. On the “Showing-off” of the Australian Bustard (*Eupodotis australis*). By A. H. GARROD, B.A., F.Z.S., Fellow of St. John’s College, Cambridge, Prosector to the Society.

[Received May 23, 1874.]

Whether the account of the production of the great distention of the neck in the male Australian Bustard which follows will in any way simplify the question of the presence or absence of a gular pouch in Bustards generally, is doubtful. At all events it will rectify an accepted error, and add a fresh fact to the considerable literature of the subject.

In the ‘Proceedings’ of this Society for 1868 (p. 471 *et seq.*), Dr. Murie pictures the sexual “show-off” in a specimen of *Eupodotis australis* which was presented to the Society in April 1866, by the Acclimatization Society of Sydney, and infers, from its appearance, that, as an undoubted fact, the gular pouch is present in this specimen of the species at least.

In 1873, during one of the months in which it was “showing off,” namely in May, I examined the mouth of this identical bird while alive, and could find no trace of a sublingual orifice, and, what is more, felt and saw a median frenum linguæ quite distinctly. This